



Toulouse, 4th June, 1999

Affaires Techniques Projets et Services Opérationnels
Sous-Direction Etudes Systèmes et Développements
Division Altimétrie et Localisation Précise
Département Missions Systèmes
18, avenue Edouard Belin
31401 TOULOUSE CEDEX 4

SSALTO

ALGORITHM DEFINITION, ACCURACY AND SPECIFICATION VOLUME 7: NEAR REAL TIME CONTROL PROCESSING

Preparation
coordinated by:

P.THIBAUT, CLS

Accepted by:

P. VINCENT, CNES

Approved by:

S. COUTIN-FAYE, CNES

| | | | | |
|---------------|-----------------------|--|----------|-----------|
| Document ref: | SMM-ST-M2-EA-11008-CN | | Issue: 2 | Update: 0 |
|---------------|-----------------------|--|----------|-----------|

| For application | DS2 | DS4 | DS5 | DH2 | DPP | DJ1 | TP | TP2 | F-PAC | DOR | AVI | SOL |
|--------------------|-----|-----|-----|-----|-----|-----|----|-----|-------|-----|-----|-----|
| | | | | | | | | X | X | | | |

| | | | |
|--------------------------------------|-----|----------------|--------|
| Configuration controlled Document | YES | by: CCM SSALTO | Since: |
|--------------------------------------|-----|----------------|--------|



**SSALTO
PROJECT**

Reference project: **SMM-ST-M2-EA-11008-CN**
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: i

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

TYPING FACILITIES

| Original typing | Storage | Softwares |
|------------------------|----------------|------------------|
| | | Office 97 |

DOCUMENT STATUS

| Page | i | ii | iii | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | | | |
|---------------|---|----|-----|--|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| Issue | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Update | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |

DOCUMENT CHANGE RECORD

| Issue | Update | Date | Modifications | Visa |
|--------------|---------------|--------------------------------|------------------------------------------------------|-------------|
| 0 | 0 | 30 th July 1998 | Document creation | |
| 1 | 0 | 12 th March 1999 | Document modifications | |
| 2 | 0 | 4 th June 1998 | Document modifications for compatibility with CMA V2 | |

ABBREVIATIONS

| Sigle | Definition |
|---------------|-----------------------------------------|
| ADA | Algorithm Definition and Accuracy |
| ADx | Applicable Document x |
| CAL | Calibration |
| CFA | Control Flag Altimeter |
| CLS | Collecte Localisation Satellite |
| CMA | Centre Multi-missions Altimètre |
| CNES | Centre National d'Etudes Spatiales |
| DAD | Dynamic Auxiliary Data |
| GDR | Geophysical Data Record |
| IGDR | Interim Geophysical Data Record |
| IONO | IONOspheric Data |
| OFL | Off- Line |
| ORF | Orbit Revolution File |
| RDx | Reference Document x |
| SAD | Statistic Auxiliary Data |
| SSALTO | Segment Sol Altimétrie et Orbitographie |
| SWH | Significant Wave height |
| TBC | To Be Confirmed |
| TBD | To Be Defined |



**SSALTO
PROJECT**

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: ii

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

APPLICABLE AND REFERENCE DOCUMENTS

| Reference | Document title |
|------------------------|-------------------------------------------------------------------------------------------------------------|
| SMM-ST-M-EA-10879-CN | AD1 SSALTO Product Specification – Volume 1: JASON-1 User Products |
| SMM-ST-M2-EA-11003-CN | AD2 Algorithm Definition, Accuracy and Specification Volume 2: CMA Altimeter Level 1B Processing |
| SMM-ST-M2-EA-11005-CN | AD3 Algorithm Definition, Accuracy and Specification Volume 4: CMA Altimeter Level 2 Processing |
| SMM-ST-M2-EA-11009-CN | AD4 Algorithm Definition, Accuracy and Specification Volume 8: CMA Off Line Control Processing |
| SMM-ST-M2-EA-11010-CN | AD5 Algorithm Definition, Accuracy and Specification Volume 9: CMA Mechanisms |
| SMM-ST-M2-EA-11011-CN | AD6 Algorithm Definition, Accuracy and Specification Volume 10: CMA Expertise processing |
| SMM-ST-M2-EA-11012-CN | AD7 Algorithm Definition, Accuracy and Specification Volume 11: CMA Visualization processing |
| SMM-SP-M2-EA-32012-CLS | AD8 CMA Production: Specification of the data management algorithms |
| SMM-SP-M2-EA-32007-CLS | AD9 Algorithm Definition, Accuracy and Specification Volume 6: Altimeter/Radiometer Verification processing |
| SMM-DD-M2-EA-32037-CLS | AD10 CMA Production : Internal Interfaces |
| TP-NT-613-697-CLS | RD1 Etat des lieux des contrôles sur POSEIDON1 |

TBC AND TBD LIST

| TBC/TBD | Paragraph | Brief description |
|----------------|------------------|--------------------------|
| TBC | / | / |
| TBD | / | / |



SSALTO
PROJECT

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: iii

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

CONTENTS

| | |
|------------------------------------------------------------------------|---|
| 1. INTRODUCTION | 1 |
| 2. INPUT AND OUTPUT DATA..... | 3 |
| 2.1. INPUT DATA..... | 3 |
| 2.2. OUTPUT DATA | 3 |
| 2.3. SUMMARY OF THE INTERFACES..... | 3 |
| 3. OVERVIEW | 4 |
| 3.1. GENERAL DESCRIPTION | 4 |
| 3.2. CONTROL OF THE PRODUCED PARAMETERS | 4 |
| 3.2.1. <i>Basis of control flag generation</i> | 5 |
| 3.2.2. <i>Control of the OSDR (1 Hz) parameters for Jason-1</i> | 6 |
| 4. FUNCTIONS..... | 9 |
| 4.1. GEN_CTL_QUA_01 - To COMPRESS AN ARRAY OF FLAGS..... | 9 |
| 4.2. GEN_CTL_QUA_03 - To DETERMINE PERCENTAGES | 9 |
| 4.3. GEN_CTL_QUA_05 - To EDIT DATA MEASUREMENTS USING THRESHOLDS | 9 |



SSALTO
PROJECT

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: 1

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

1. INTRODUCTION

This document is aimed at defining and at specifying the functions of the control processing for the near real time products (OSDR). The mission concerned is JASON-1. The phase of control processing begins automatically after the computation of the parameters. The data distribution is conditioned by the results of the control phase. The data flow considered is the same as the flow just computed.

The algorithms of the near real time control processing are defined and are specified in order to be used for several kinds of parameters. These parameters are issued from the altimeter or radiometer or DORIS of JASON-1. All the parameters (1Hz) that are computed in the corresponding chains and that are written in the external output product (OSDR) have to be controlled.

The definitions and specifications of the near real time control processing are derived from the specifications of the corresponding POSEIDON-1 processing (RD1), accounting for the evolution of POSEIDON-2 with respect to POSEIDON-1 (AD2). The algorithms used for the Off Line control are defined and specified in AD4.

Definition of the near real time control processing

The definition of the near real time control processing consists of the identification and the description of the main functions. It will provide the reader with an overview of the processing and a global understanding of the algorithms.

Specification of the near real time control processing

Regarding the specifications of the near real time control processing, two kinds of algorithms are distinguished:

- The “scientific” algorithms, which represent the core of the processing
- The other algorithms, which will be called the “data management algorithms”, ensuring functions such as:
 - To get the input data
 - To prepare the data to be processed
 - To perform unit conversions or changes of reference systems
 - To perform general checks (relative for example to the presence of input files, to the data conformity or to the compatibility of input data with the data set to be processed)
 - To build the output product(s)
 - To manage the processing

The “scientific” algorithms are specified in this document or specified as mechanisms (AD5), while the “data management algorithms”, which strongly depend on the format of the input and output data, are specified in AD8. The complete set of specifications (to be associated to the corresponding interface documents) is intended for the team in charge of the software development.

Most of the algorithms used in the near real time control processing can be seen as mechanisms and are defined in AD5. The algorithms described in this document can be considered as a baseline. Most of them are also used in the Off Line Control Processing (AD4) and in the Verification Processing (AD9).



**SSALTO
PROJECT**

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: 2

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

Organization of the document

- The interfaces of the processing (input and output data) are defined in section 2.
- An overview of the processing is given in section 3. It consists of the presentation of the general flowchart, and of a brief description of the control of the OSDR parameters.
- The detailed description of the algorithms is finally given in section 4.

For the near real time control processing, the description consists in:

- An overview of the overall processing (list of functions).
- The definition and the specification of the algorithms, using the following items:
 - * Name and identifier of the algorithm
 - * Heritage
 - * Function
 - * Applicability to the various processing procedures
 - * Algorithm definition:
 - ◇ Input data
 - ◇ Output data
 - ◇ Mathematical statement
 - * Algorithm specification:
 - ◇ Input data
 - ◇ Output data
 - ◇ Processing
 - * Accuracy (if any)
 - * Comments (if any)
 - * References (if any)

The general information required for a global understanding of the algorithm within the overall processing is provided in the “Algorithm definition” sections.

The detailed information required by the team in charge of the software development is provided in the “Algorithm specification” sections, which precisely define the scientific part (i.e. the core) of the algorithms.

Basic rules

The following basic rules relative to the specification of the algorithms are applied:

- Elementary functions that are common to several algorithms (also called “mechanisms”) are specified in AD5.
- The input and output data are always identified by a precise description, an explicit name (that may be used in the coding phase), a unit and if necessary a reference system.
- Regarding the errors that may occur during the processing (for example, negative argument for logarithmic or square root functions), the algorithms systematically output an execution status. The building and the management of this information will be defined during the architectural design of the software.



- Regarding the representation of tables, the following conventions are used:
 - $X[N_1:N_2]$ represents a one-dimension table whose elements are $X(i)$ (or X_i) with $i \in [N_1, N_2]$
 - $X[N_1:N_2][M_1:M_2]$ represents a two-dimension table whose elements are $X(i,j)$ (or X_{ij}) with $i \in [N_1, N_2]$ and $j \in [M_1, M_2]$
 - And so on

2. INPUT AND OUTPUT DATA

2.1. INPUT DATA

Input data consist of three types of data:

- Product data, which may be:
 - level 1b altimeter and radiometer parameters for JASON-1
 - level 2 altimeter and radiometer parameters for JASON-1
 - DORIS parameters
- Dynamic auxiliary data: None
- Static auxiliary data:
 - List of thresholds, processing parameters, universal constant data.

It is assumed that the level 1.0 is controlled by the CCI.

2.2. OUTPUT DATA

Output data consist of two types of data:

- altimeter or radiometer flags
- editing reports

2.3. SUMMARY OF THE INTERFACES

The interfaces of the near real time control processing are summed up in **Figure 1**.

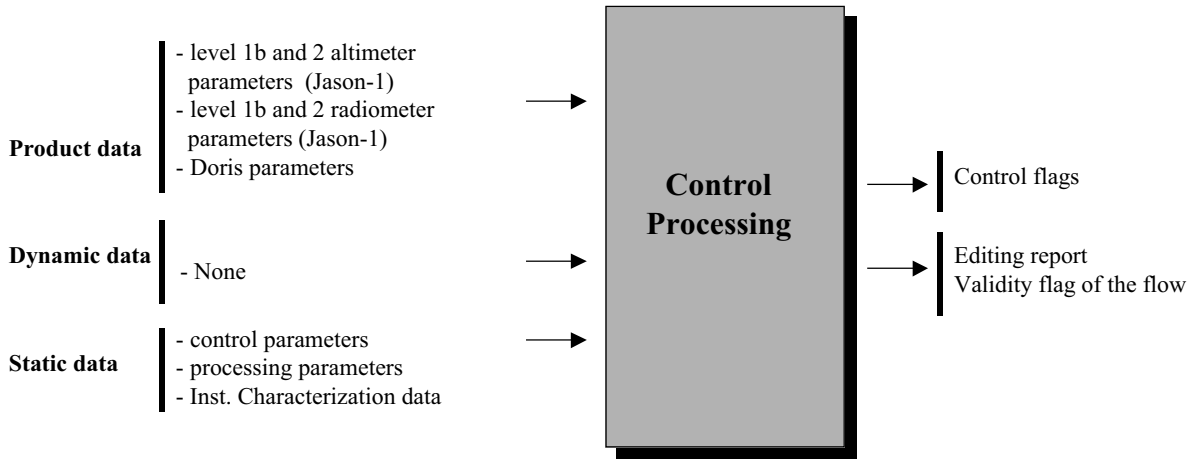


Figure 1: Interfaces of the near real time control processing

3. OVERVIEW

3.1. GENERAL DESCRIPTION

The near real time control processing is aimed at controlling the 1Hz parameters of the OSDR product. The control is performed on the “ocean” data.


3.2. CONTROL OF THE PRODUCED PARAMETERS

The aim of the control processing for the produced parameters is to:

- detect the outliers with respect to predefined thresholds that are given in the control parameters files
- generate a set of quality flags for the computed parameters
- determine statistical characteristics of the parameters (mean, standard deviation)
- generate quality flags for the data flow

As already stated, the following types of parameters are to be controlled:

- Altimeter and Radiometer (1 Hz) parameters for Jason-1
- DORIS parameters

| | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p style="text-align: center;">SSALTO PROJECT</p> | <p>Reference project: SMM-ST-M2-EA-11008-CN</p> <p>Issue N°: 2 Update N°: 0</p> <p>Date: 4th June, 1999 Page: 5</p> |
| <p>Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING</p> | |

3.2.1. BASIS OF CONTROL FLAG GENERATION

The data flow in input of the control processing consists of N measurements (measurements are at the rhythm of 1 Hz for the OSDR parameters). Each of these measurements contains several fields that can be grouped in families. For example, the OSDR (Jason) parameters can be split in several families like “significant waveheight”, “backscatter coefficient”, “altimeter range”.

The control consists in several algorithms:

- 1st algorithm: setting flags by comparison with predefined thresholds (field or combination of fields can be checked). This phase is aimed at generating a validity flag (2 states: “valid” or “invalid”) for each field (or combination of fields) of each measurement of the flow depending on the result of the comparison of the measurement with predefined thresholds. This procedure is performed using the (See AD4 “GEN_CTL_QUA_05 - To edit data measurements using thresholdsREF”).
- 2nd algorithm: computing a “family flag” taking into account the flags of all fields in the family.
 - If the flags of all the fields of the family are “valid”, the family flag is set to “valid”.
 - If the flag (at least) of one field of the family is “invalid”, the family flag is set to “invalid”.

This computation is performed using the algorithm “GEN_CTL_QUA_01 - To compress an array of flags”.

- 3rd algorithm: a “general” flag is computed taking into account the flags of all families (for each measurement).
 - If the flags of all the families are “valid”, the total flag is set to “valid”.
 - If the flag (at least) of one family is “invalid”, the total flag is set to “invalid”.

This computation is performed using the algorithm “ GEN_CTL_QUA_01 - To compress an array of flags”.

- 4th algorithm: counting the “valid” and “invalid” data measurements. The percentages of valid and invalid data on the flow are then computed.

This computation is performed using the algorithm “ GEN_CTL_QUA_03 - To determine percentages”.

Figure 2 sums up the whole flags management in the control processing of the produced parameters. “Valid” flags are set to “0” and “Invalid” flags are set to “1”.

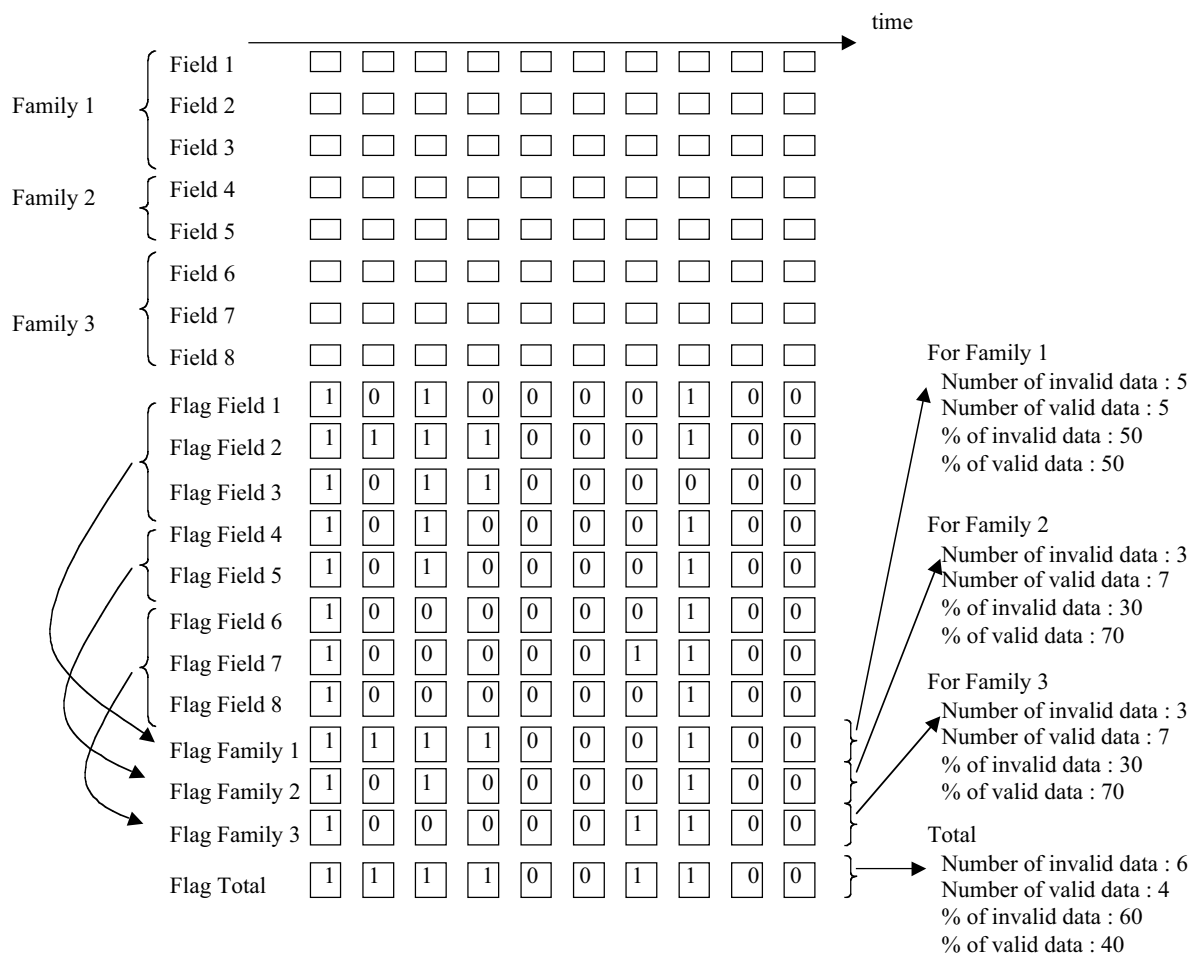


Figure 2: flags management

By definition, the control processing doesn't consider the following type of control:

- "Production flags" generated by the production processing are not described in this document but are described in the production algorithms at different levels (1.0, 1b, 2).

The visualization functions are defined in the AD7.

3.2.2. CONTROL OF THE OSDR (1 Hz) PARAMETERS FOR JASON-1

For these parameters, the control is performed on the "ocean" data for JASON-1. In input, each measurement has an "over-flown surface flag".

The 1 Hz parameters (or combination of parameters) that are written in the OSDR product are likely to be controlled using the processing steps that have been described in the previous section.



**SSALTO
PROJECT**

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: 7

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

The 1st, 2nd, 3rd and 4th algorithms are used.

If the percentage of “valid” data obtained from the 4th step is greater (or equal to) than a predefined value, the flow is declared “OK” and the general validity flag of this flow is set to “valid”. If the percentage of “valid” data obtained by the 4th step is smaller than a predefined value, the flow is declared “NOK” and the general validity flag of this flow is set to “invalid”.

In the OSDR product, the parameters can be split in families: “On board retracked significant waveheight”, “On board retracked backscatter coefficient”, “On board retracked altimeter range”, “off nadir angle”, “brightness temperatures”, “environmental parameters”.

The following table gives the list of parameters that can be controlled. The algorithm(s) that product(s) the parameter is identified in the third column. These algorithms are defined and specified in AD2.

| Field Number | Parameter | Algorithm(s) |
|--------------|---------------------|---------------------------------------------------------|
| 1 | Range_Main | ALT_COR_RAN_04 |
| 2 | RMS_Range_Main | ALT_COM_RAN_04 |
| 3 | NVP_Range_Main | ALT_COM_RAN_04 |
| 4 | Range_Aux | ALT_COR_RAN_04 |
| 5 | RMS_Range_Aux | ALT_COM_RAN_04 |
| 6 | NVP_Range_Aux | ALT_COM_RAN_04 |
| 7 | SWH_Main | ALT_COR_SWH_01 |
| 8 | RMS_SWH_Main | from Alt 1.0 (controlled only if SWH_Main is computed) |
| 9 | NVP_SWH_Main | from Alt 1.0 (controlled only if SWH_Main is computed) |
| 10 | Sig0_Main | ALT_PHY_WIN_01 |
| 11 | RMS_Sig0_Main | from Alt 1.0 (controlled only if Sig0_Main is computed) |
| 12 | Sig0_Aux | ALT_PHY_WIN_01 |
| 13 | RMS_Sig0_Aux | from Alt 1.0 (controlled only if Sig0_Main is computed) |
| 14 | Off_Angle_Wave_Main | ALT_COM_MIS_01 |
| 15 | Rad_BT1 | RAD_PHY_TEM_01 |
| 16 | Rad_BT2 | RAD_PHY_TEM_01 |



**SSALTO
PROJECT**

Reference project: **SMM-ST-M2-EA-11008-CN**
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: 8

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

| | | |
|----|--------------------------|----------------|
| 17 | Rad_BT3 | RAD_PHY_TEM_01 |
| 18 | Rad_Wind | RAD_PHY_GEN_01 |
| 19 | Rad_Water_Vapour_Content | RAD_PHY_GEN_01 |
| 20 | Rad_Liquid_Water | RAD_PHY_GEN_01 |
| 21 | Alt_Wind | ALT_PHY_WIN_01 |
| 22 | Alt_TEC | ALT_COR_RAN_12 |

The flags corresponding to each parameter described above are grouped by families. The list of flags and families are given in Annex 1 of AD10.

Family flags are constructed as it has been described (2nd step) and correspond to the bitfields described in A1 of AD10.

As previously seen in section 3.2.1, general flags are then computed from family flags according to the following table:

| | Flag_Gen_Main | Flag_Gen_Aux | Flag_Gen_Other | Flag_Gen_Final |
|---------------------|---------------|--------------|----------------|----------------|
| Flag_Fam_Range_Main | | | | |
| Flag_Fam_Range_Aux | | | | |
| Flag_Fam_SWH_Main | | | | |
| Flag_Fam_Sig0_Main | | | | |
| Flag_Fam_Sig0_Aux | | | | |
| Flag_Fam_Off_Angle | | | | |
| Flag_Fam_Rad_BT | | | | |
| Flag_Env_Par | | | | |
| Flag_Gen_Main | | | | |
| Flag_Gen_Aux | | | | |
| Flag_Gen_Other | | | | |

Figure 3 : Construction of the general flags from family flags

The percentages of valid and invalid data are computed with the values of these flags:

“Perc_Valid_Main” and “Perc_Non_Valid_Main” are computed with Flag_Gen_Main

“Perc_Valid_Aux” and “Perc_Non_Valid_Aux” are computed with Flag_Gen_Aux

“Perc_Valid_Other” and “Perc_Non_Valid_Other” are computed with Flag_Gen_Other

The general percentages of valid and invalid data are computed with Flag_Gen_Final: “Perc_Valid_Global” and “Perc_Non_Valid_Global”.



SSALTO
PROJECT

Reference project: SMM-ST-M2-EA-11008-CN
Issue N°: 2 Update N°: 0
Date: 4th June, 1999 Page: 9

Algorithm Definition, Accuracy and Specification Volume 7: NEAR REAL TIME CONTROL PROCESSING

4. FUNCTIONS

A list of the functions of the near real time control processing is given in figure 4.

| APPLICABILITY | ALGORITHMS |
|---------------|-------------------------------------------------------------|
| JASON-1 | |
| OSDR Product | |
| | GEN_CTL_QUA_01 - To compress an array of flags |
| | GEN_CTL_QUA_03 - To determine percentages |
| | GEN_CTL_QUA_05 - To edit data measurements using thresholds |

Figure 4: functions of the Near Real Time Control Processing

4.1. GEN CTL QUA 01 - TO COMPRESS AN ARRAY OF FLAGS

See AD4

4.2. GEN CTL QUA 03 - TO DETERMINE PERCENTAGES

See AD4

4.3. GEN CTL QUA 05 - TO EDIT DATA MEASUREMENTS USING THRESHOLDS

See AD4

DISTRIBUTION LIST

INTERNAL:

| | | | |
|----------------|----------------|---------|--|
| P. ESCUDIER | DGA/T/ED/AL/D | PB 2002 | |
| | | | |
| A. AURIOL | DGA/T/ED/AL/DO | " | |
| M. COSTES | | " | |
| | | | |
| F. PARISOT | DGA/T/ED/AL/TO | | |
| P. HOZE | | | |
| J. PERBOS | | | |
| M. BLUMBERGER | | | |
| G. ZAOUCHE | | | |
| | | | |
| S. COUTIN-FAYE | DGA/T/ED/AL/MA | " | |
| J. NOUBEL | | " | |
| P. VINCENT | | | |
| B. DELATTE | | | |
| B. BONHOURE | | | |
| N. PICOT | | | |
| G. TAVERNIER | | | |
| | | | |
| R. QUINTARD | DGA/T/ED/SG/CP | " | |
| P. SNINI | | " | |
| P. GILLEN | | | |
| | | | |
| G. BOUTONNET | DGA/T/TI/PS | BP 1501 | |
| M. H. GOMEZ | | BP 211 | |
| | | | |

EXTERNAL:

| | | | |
|---------------|-----|--|--|
| M. DESTOUESSE | CLS | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |